

Application of a new model of density layers of matter to the expanding gaseous envelope of the star HD 66811.

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1 Introduction

The main parameters of the star were summarized by Lamers and Morton (1976). The determination of the effective temperature yields large problems. The value derived from the angular diameter and the UV flux distributions is $T_e = 32510 \pm 1930$ K according to Code et al. (1976) or 31900 ± 1800 K according to Brune et al. (1979). An absolutely calibrated rocket spectrum (12 to 15 Å resolution) was obtained by Brune et al. (1979). These investigations revealed strong P Cygni lines of C IV, N IV N V, O IV, Si IV, S IV and S VI in the far ultraviolet. Additionally, Snijders and Underhill (1975) analyzed the He II observed by the COPERNICUS satellite along with those available from ground-based spectra. Finally, Franco et al. (1983) found line profile variability in ζ Puppis and suggested that two different mechanisms could produce the observed ionization stages.

2 The UV data

In this project the coronal region's study of star HD 66811 is based on the IUE spectrum SWP 05963 taken on July 27th 1979 and we study the structure of the spectral lines of: SiIV $\lambda\lambda$ 1393.755 Å, 1402.730 Å., NV λ 1718.55 Å, CIV $\lambda\lambda$ 1548.18 Å, 1550.77 Å, NIV $\lambda\lambda$ 1238.821 Å, 1242.804 Å.

3 The atmospherical model

Considering an area of gas consisting of i independent absorbing shells followed by a shell that both absorbs and emits and an outer shell of general absorption, we conclude to the function:

$$I_\lambda = [I_{\lambda_0} \exp\{-L_{\lambda e} \xi_e\} \prod_i \exp\{-L_{\lambda i} \xi_i\} + \Theta_0(1 - \exp\{-L_{\lambda e} \xi_e\})] \exp\{-L_{\lambda g} \xi_g\} \quad (1)$$

where: I_{λ_0} : the initial radiation intensity, L_i , $L_{\lambda e}$, $L_{\lambda g}$: functions of the rotational and the expansion/contraction velocities ($v \sin(i)$, v_{ex}/c), $\xi = \int_0^s \Omega \rho ds$, where Ω : an expression of k_λ , Θ_0 : the source function $S_{\lambda e}$, which, at the moment when the spectrum is taken, is constant and $L = \sqrt{1 - \cos^2 \theta}$, if $\cos(\theta_0) < 1$, or $L = 0$, if $\cos(\theta_0) \geq 1$ where: $\cos(\theta_0) = \frac{-\lambda_0 + \sqrt{\lambda_0^2 + 4\Delta\lambda^2}}{2\Delta\lambda z_0} < 1$ where: λ_0 is the wavelength of the center of the spectral line and $\lambda_0 = \lambda_{lab} + \Delta\lambda_{exp}$, where λ_{lab} is the laboratory wavelength of the spectral line and $\Delta\lambda_{exp}$ is the radial Doppler shift and $z_0 = \frac{v_{exp}}{c}$, where v_{exp} is the apparent rotational velocity of the i density shell of matter. $\Delta\lambda = |\lambda_i - \lambda_0|$, where the values of λ_i are taken in the wavelength range we want to reproduce.

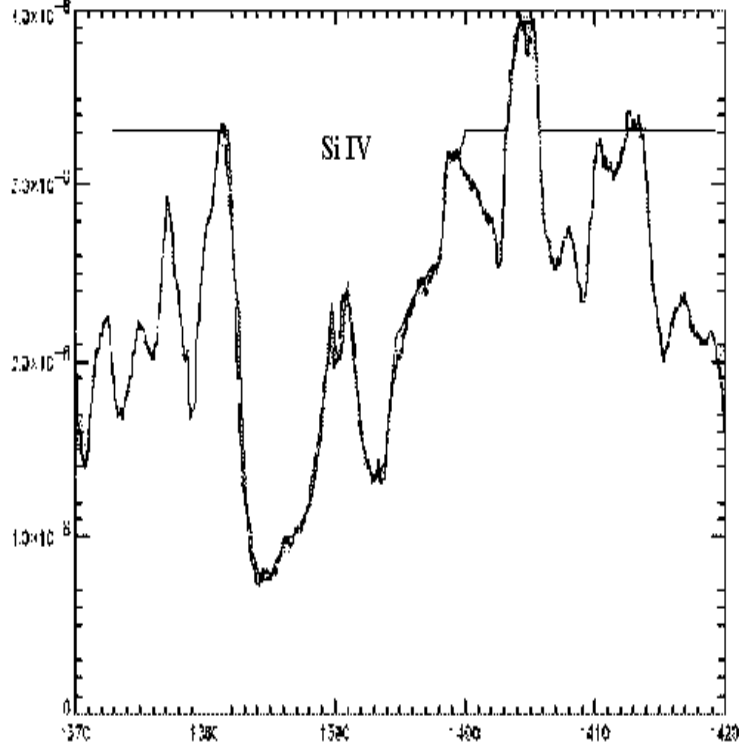


Figure 1: The N IV λ 1718,80 Å line of HD 66811 shows a characteristic P Cygni profile, which is formed as a composition of four independent absorption and one emission components.

4 Tables and Figures

The following figures illustrate the spectral lines and the best fit using the model we described. The tables below the figures show the radial velocities of expansion or contraction as well as the apparent velocities of rotation of all the observed layers of matter. The histograms represent the expansion or contraction's radial velocities of all the observed layers of matter for the above mentioned ions, as a function of atmospheric depth.

5 The model's fit

<i>SWP05963</i>	$V_{a1}(km/s)$	$V_{a2}(km/s)$	$V_{a3}(km/s)$	$V_e(km/s)$
NV (mean)	-2080 ± 28	-920 ± 2	-1412 ± 11	-1463 ± 2

<i>SWP05963</i>	$V_{rot1}(km/s)$	$V_{rot2}(km/s)$	$V_{rot3}(km/s)$
NV (mean)	600 ± 0	570 ± 0	550 ± 0

<i>SWP05963</i>	$V_{a1}(km/s)$	$V_{a2}(km/s)$	$V_{a3}(km/s)$	$V_{a4}(km/s)$	$V_e(km/s)$
NIV (mean)	-1309	-873	-611	-244	+517

<i>SWP05963</i>	$V_{rot1}(km/s)$	$V_{rot2}(km/s)$	$V_{rot3}(km/s)$	$V_{rot4}(km/s)$
NIV (mean)	558	580	570	80

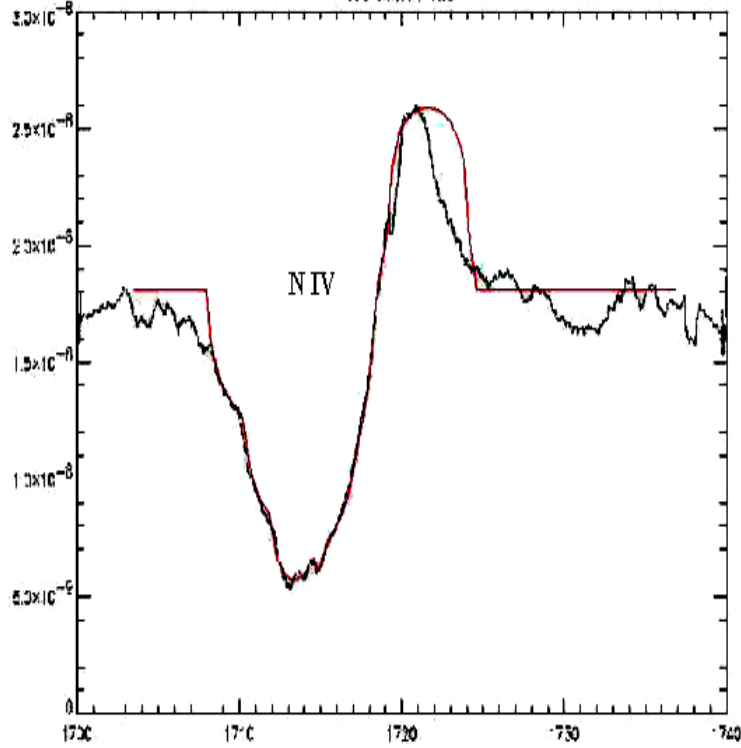


Figure 2: Each of Si IV $\lambda\lambda$ 1393,755 Å, 1402,730 Å resonance lines of HD 66811 shows a clear (Characteristic) P Cygni profile which is formed as a composition of three independent absorption and one emission components.

<i>SWP05963</i>	$V_{a1}(km/s)$	$V_{a2}(km/s)$	$V_{a3}(km/s)$	$V_e(km/s)$
Si IV (mean)	-2093 ± 7	-1492 ± 5	-720 ± 2	$+434\pm34$

<i>SWP05963</i>	$V_{rot1}(km/s)$	$V_{rot2}(km/s)$	$V_{rot3}(km/s)$
Si IV (mean)	415 ± 15	710 ± 10	140 ± 0

<i>SWP05963</i>	$V_{a1}(km/s)$	$V_{a2}(km/s)$	$V_{a3}(km/s)$	$V_e(km/s)$
CIV (mean)	-1466 ± 1	-2183 ± 2	-171 ± 0	$+913\pm1$

<i>SWP05963</i>	$V_{rot1}(km/s)$	$V_{rot2}(km/s)$	$V_{rot3}(km/s)$
CIV (mean)	733 ± 13	748 ± 2	177 ± 0

6 Conclusions

1) The best fit of all lines derived by the model we described leads to the conclusion that the layer of matter in the region we studied 33eV (Si IV)-78 eV(N V) is structured as the model describes:

- An area of gas consisting of i independent absorbing layers of matter
- One emitting layer of matter, which follows the absorbing layers.
- Occasionally, an external absorption layer of matter.

2) It is interesting to point out the presence, in the region we study, of successive shells that expand or contract with velocities between -2247 km/sec and 1566 km/sec, while the apparent rotation velocities in this region vary between 433 km/sec and 1566 km/sec.

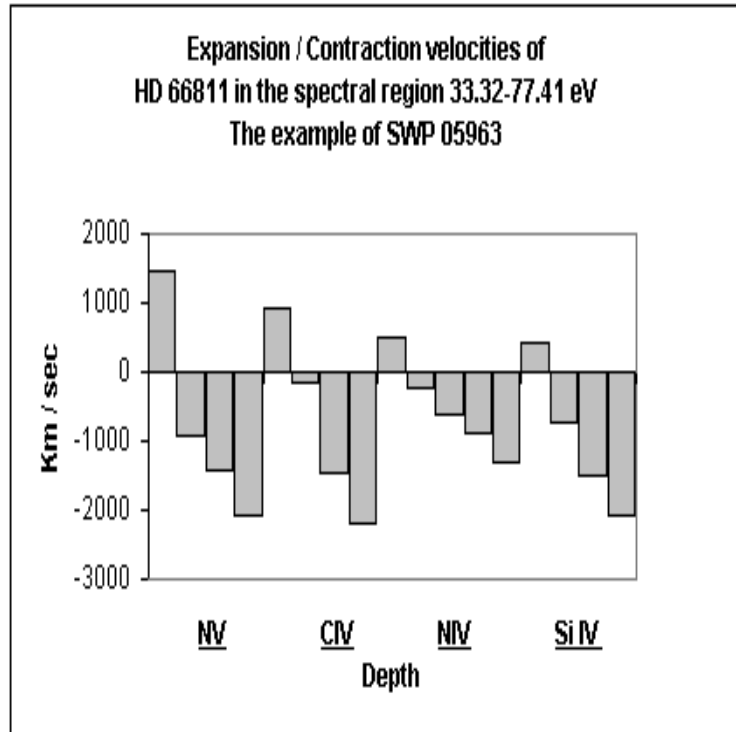


Figure 3: Expansion/Contraction velocities (kms^{-1}) of the envelope regions of HD 66811 in the spectral region 33.32-77.41 eV

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